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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/591,093

08/29/2006

Jiro Kondo

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EXAMINER

COHEN, STEFANIE J

ART UNIT

PAPER NUMBER

1793

MAIL DATE

DELIVERY MODE

04/09/2009

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/591,093	Applicant(s) KONDO ET AL.	
	Examiner STEFANIE COHEN	Art Unit 1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 January 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/29/2006; 10/20/2006; 8/18/2008</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The claim to foreign priority under 35 U.S.C. 119 and receipt of a certified copy of the priority document is acknowledged and taken into account in this action.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schei (5788945) in view of Schmid et al (6368403) and further in view of Mellstrom (WO8902415).

Schei, col. 3 lines 27-35, teaches a method of refining silicon where slag having a lower density than molten silicon is continuously or substantially continuously supplied to the molten silicon through the bottom or through the lower part of the vessel containing the molten silicon whereby the slag will rise to the top of the molten silicon where the slag is continuously or substantially continuously removed from the vessel. Slag based on Na₂O-SiO₂ is an example of slag having a lower density than silicon.

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Although Schei teaches introducing $\text{Na}_2\text{O-SiO}_2$ into the molten silicon as already molten slag, Schei does not teach introducing $\text{Na}_2\text{O-SiO}_2$ into the molten silicon in a powder form.

Schmid, col. 5 lines 1-10, teaches a method for purifying silicon where silica powder can be introduced as a reactant for molten silicon to form a slag containing the silica powder and impurities in the molten silicon. Further, the addition of certain powders such as CaO powder makes the slag more basic and thus allows it to trap impurities.

It would have been obvious to one of ordinary skill in the art at the time of the invention to substitute the powder form of CaO-SiO_2 as taught by Schmid in for the $\text{Na}_2\text{O-SiO}_2$ as taught by Schei in the molten silicon because silica powder and calcium oxide powder are generally known for use in slag. Further, introducing silica and CaO in powder form eliminates the step of heating these components separately to form slag before introduction to the molten silicon. Further, it would have been obvious to one of ordinary skill in the art at the time of the invention to maximize the purity of the final silicon product.

It would have been obvious to one of ordinary skill in the art at the time of the invention that powder Na_2O can be substituted in for powder CaO because both are considered strong bases and therefore both have the ability to extract boron out of the molten silicon and further Na_2O has the ability to rise to the top of the molten silicon.

Although Schei in view of Schmid teaches a method for refining silicon where silica powder and calcium oxide powder is introduced to molten silicon, neither teaches introducing a powder of an alkali carbonate metal.

Mellstrom, pgs. 3 and 4, teaches a method for the purification of silicon where at least one compound selected from the group consisting of oxides, carbonates and hydroxides of alkali and/or alkaline earth metals is added to the molten slag.

It would have been obvious to one of ordinary skill in the art at the time of the invention that powdered sodium carbonate can be substituted in for sodium oxide because Mellstrom teaches sodium carbonate or sodium oxide would result in the same percentage of silicon purification.

Regarding claim 2, Schei, col. 3 lines 27-35, teaches a method of refining silicon where slag having a lower density than molten silicon is continuously or substantially continuously supplied to the molten silicon through the bottom or through the lower part of the vessel containing the molten silicon whereby the slag will rise to the top of the molten silicon where the slag is continuously or substantially continuously removed from the vessel.

Regarding claims 3 and 6, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the interval time of adding the additives to discharging to achieve maximum purification of the silicon material.

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Regarding claims 4-5 and 7, it would have been obvious to one of ordinary skill in the art at the time of the invention that the order of the addition of the slag materials would have no impact on the final silicon product as long as all the components are well mixed.

Regarding claims 8 and 10, it would have been obvious to one of ordinary skill in the art at the time of the invention to discharge already formed slag as many times as needed to obtain additional space for further treatment of the raw silicon having a boron concentration. Schei, col. 3 lines 27-35, further teaches the slag will rise to the top of the molten silicon where the slag is continuously or substantially continuously removed from the vessel.

Regarding claim 9, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the interval time of adding the additives to discharging the formed slag to achieve maximum purification of the silicon material.

Regarding claim 11, Schei, example 1, teaches the boron content of the refined silicon was about 1 ppmw. Further, Schmid, col. 1 lines 20-25, teaches the final silicon product should have no more than 5 ppm of metallic impurities.

Further, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the number of times the slag is discharged to obtain a desired boron concentration.

Regarding claim 12, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the quantity of silica and sodium carbonate added to the molten silicon to obtain the purist form of silicon.

Regarding claim 13, Schei, example 1, teaches a mole of silicon in the SiO_2 is .666 times the mole of the CaO .

Regarding claims 14 and 15, it would have been obvious to one of ordinary skill in the art at the time of the invention that powder Na_2O can be substituted in for powder CaO because both are considered strong bases and therefore both have the ability to extract boron out of the molten silicon and further Na_2O has the ability to rise to the top of the molten silicon

Further, Mellstrom, pgs. 3 and 4, teaches a method for the purification of silicon where at least one compound selected from the group consisting of oxides, carbonates and hydroxides of alkali and/or alkaline earth metals is added to the molten slag.

It would have been obvious to one of ordinary skill in the art at the time of the invention that powdered sodium carbonate can be substituted in for sodium oxide because Mellstrom teaches sodium carbonate or sodium oxide would result in the same percentage of silicon purification.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schei (5788945) in view of Schmid et al (6368403) and Mellstrom (WO890215) as applied to claim 1 and further in view of Hurley (1992).

Although Schmid teaches adding alumina to the molten silicon to lower the melting point of the slag, Schei and Schmid do not teach adding alumina increase the viscosity of the slag.

Hurley, abstract, teaches a slag composition where the addition of alumina increases the viscosity and the Tc of the slag and therefore making the slag less corrosive.

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate alumina as taught by Hurley in molten silicon/ slag composition because Hurley teaches the alumina will increase the viscosity and the Tc of the molten silicon/slag mixture and therefore make the slag less corrosive.

Response to Arguments

Applicant's arguments, filed 1/28/2009, with respect to the rejection(s) of claim(s) 1-16 under Fujiwara have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Schei and Schmid and Schei, Schmid and Hurley.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to STEFANIE COHEN whose telephone number is

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(571)270-5836. The examiner can normally be reached on Monday through Thursday 9:3am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Melvin Curtis Mayes can be reached on 5712721234. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Stefanie Cohen

3/20/2009

SC

March 21, 2009

/Melvin Curtis Mayes/
Supervisory Patent Examiner, Art Unit 1793